

ABSTRACT

Title of talk: "Correction of excessive precipitation over steep and high mountains in a General Circulation Model"

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Excessive precipitation over steep and high mountains (EPSM) is a well-known problem in GCMs and meso-scale models. This problem impairs simulation and data assimilation products. Among the possible causes investigated in this study, we found that the most important one, by far, is a missing upward transport of heat out of the boundary layer due to the vertical circulations forced by the daytime upslope winds, which are forced by the heated boundary layer on subgrid-scale slopes. These upslope winds are associated with large subgrid-scale topographic variation, which is found over steep and high mountains. Without such subgrid-scale heat ventilation, the resolvable-scale upslope flow in the boundary layer generated by surface sensible heat flux along the mountain slopes is excessive. Such an excessive resolvable-scale upslope flow combined with the high moisture content in the boundary layer results in excessive moisture transport toward mountaintops, which in turn gives rise to EPSM. Other possible causes of EPSM that we have investigated include 1) a poorly-designed horizontal moisture flux in the terrain-following coordinates, 2) the condition for cumulus convection being too easily satisfied at mountaintops, 3) the presence of conditional instability of the computational kind, and 4) the absence of blocked flow drag. These are all minor or inconsequential.

We have parameterized the ventilation effects of the subgrid-scale heated-slope-induced vertical circulation (SHVC) by removing heat from the boundary layer and depositing it in layers higher up when the topographic variance exceeds a critical value. Test results using NASA/Goddard's GEOS-5 GCM have shown that this largely solved the EPSM problem.